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Utilizing Orthophoto Through Adaptive Re-Use Courses in Architecture Education

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Abstract
With the developing technologies, digital-based technologies and methods used in the field of architecture, as in every field, are increasing. This situation causes the methods used in architectural education to change. This study examines the use of terrestrial laser scanning technologies as a new method in adaptive re-use in the distance education process of architectural education. The aim of the study is to examine the use of Terrestrial Laser Scanning technologies in the adaptive re-use projects of architecture in the distance education process, by comparing it with the conventional method in face-to-face education process, to analyse whether it is an efficient method and to investigate its contributions, if any. In the experimental study, it was tried to find the answer to the question of whether the use of orthophoto produced from terrestrial laser scanning technologies as a method within the extent of re-use historical buildings is an efficient method compared to the conventional method. Orthophoto images obtained from Terrestrial Laser Scanning technologies will be used in the project of re-use a historical building, and the conduct of the course in distance education will be investigated. In this research the comparative analysis method was used in 25 student projects were evaluated. In the analyses made, the average success scores according to the parameters, the most positive and negative aspects of the projects, the general evaluation of the projects were compared and interpreted in the findings section. According to the analyses, firstly, whether the orthophoto method is efficient compared to the traditional method was examined and then the efficient aspects were determined. It is thought that being able to access measurable, comparable, and high-accuracy data without going to the place is an alternative and useful method in the emergency distance education period. However, the application of site study and learning methods by practice is important for the development of the student's mastery of the process and should not be ignored. In future studies, it is foreseen that the research will lead to new discussions on originality, creativity, and the use of different 2D, 3D, and hybrid techniques and presentation tools in presentation formats, since each project is designed on the supplied ready-made bases.

Keywords:
Adaptive re-use, Architectural education, Distance education, Terrestrial laser scanning technologies

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INTRODUCTION

Architecture is a discipline consisting of design and production processes, so it is a field that constantly renews and updates itself. With the developing technologies, the use of technology in architecture and architectural education is becoming more and more widespread. Two- and three-dimensional technologies are used in areas such as drawing, modeling, prototyping, 3D printers, and laser cutting during the design and production stages. In addition, terrestrial laser scanning technologies are used, especially in projects for the refunctioning and reuse of historical buildings. With this technology, the survey and architectural documentation stages, which require a long time and labor, can be prepared with high accuracy in a much shorter time. With the development of technology, the technologies used in the field of architecture have also participated in architectural education and the education has been updated.

The COVID-19 pandemic, which has had an impact all over the world, has made the transition to emergency distance education compulsory, considering the risk factors. Thus, as in every field, some disruptions and questions have emerged in architectural education. Although the Covid-19 pandemic, which brings along a series of questions about the difficulties encountered in architectural education and the future of the methods used in universities today, is characterized as a crisis, it has created an environment of opportunity that offers solutions to problems (Salama and Crosbie, 2020).

Design studios and applications which are considered the core of architectural education and one of the main topics of academic research have become a matter of distance education due to the pandemic. This necessity and urgent change situation necessitates adaptation to the distance education process. In the case where a course taught with conventional methods will be taught with distance education each of which needs (need for tools and equipment, student concentration, change of environment, technology usage skills, internet access, etc.) to be considered and planned separately.

In their study, Megahed and Hassan (2021) examine the blended education method of architectural education, remotely and face-to-face, during and after the COVID-19 pandemic. The pandemic and the conditions it brought with it have led to questions about the applicability of different methods as well as conventional methods. In the research, questions about what kind of technology-based models can be used in architectural education, whether distance education can be efficient, especially in design and studio-based approaches, and the effects of blended learning models on students are discussed. In the study, it was concluded that the blended learning strategy in architectural education will support the professional development of students in the post-pandemic period (Megahed & Hassan, 2021).

In their study, Ceylan et al. (2020) examined the perspectives of architecture students on online studio courses during the COVID-19

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pandemic. A questionnaire was used to get the opinions of the students on the selected sample. In the research, it was concluded that students benefit from using digital design tools, that necessary tools are provided in the distance education process, and that students can perform an effective study when they are given the chance to realize themselves. This study is important in terms of understanding the expectations of students from distance education and determining the issues that need to be emphasized for the next semester (Ceylan et al., 2020).

Based on these, it can be thought that it is expected to be implemented in the future as face-to-face and distance education in the curricula of architectural education, and accordingly, new methods will be developed and implemented. According to the research, in the technology-based distance education process, it is necessary to research and develop methods that will increase the interaction of digital-based design and tools with students.

The advancements in technology have led to significant innovations in techniques and methodologies used in fields such as topography, measurement, and construction. Substantial progress has been made in 3D data collection, representation, processing, and measurement. As a result, specialized documentation tools like 3D surface models, solid models, virtual models, textured surfaces, and animations have been developed. The progress in sensor technology and increased computing power has brought functionality and flexibility to spatial modeling through georeferenced technologies in contemporary times (Yılmaz and Yakar, 2006).

Architectural documentation has become a crucial tool for documenting, visualizing, and understanding structures, historical buildings, landscapes, and ruins. Such analytical studies are also essential for understanding cultural heritage. While realistic graphics and illustrations were predominantly used in the past, various data management techniques have been developed in recent years for the analysis of raw documentary data. In the architectural documentation process, laser scanning is widely used in areas such as urban studies, historical sites, archaeological sites, and significant structures or architectural remnants. Particularly, laser scanning is used alongside photogrammetric techniques for documenting large-scale areas like historic neighborhoods, archaeological sites, and monuments. In cases where traditional methods may not be sufficient and yield consistent results, laser scanning is necessary for documenting deformation, structural analysis, and material measurement (Korumaz et al., 2010).

In the study conducted at Akhan Caravanserai, laser scanning was employed in the preservation and documentation of cultural heritage to prepare a conservation project and take necessary measurements (Yakar et al., 2009). In Ağzıkara Han, terrestrial laser scanning technique was used for detailed digital documentation, resulting in a 3D point cloud (Kanun et al., 2021).

Ensuring the continuity and sustainability of cultural heritage requires the identification, documentation, and protection of the structure's material issues before its demolition. Laser scanning data were utilized to detect and document material deteriorations on the facades of Şanlıurfa Kışla Mosque, providing significant time and labor savings for analytical purposes (Karataş et al., 2022a). In the case of the historic Diyarbakır Sur Mansion, analytical research was conducted with sufficient detail in architectural documentation based on orthophoto images (Karataş et al., 2022b).

Laser scanning is also beneficial in detecting material damages. In their study, Karataş et al. (2022c) used this method to investigate and identify deteriorations on the stone materials that constitute the historic Burdur Railway Station Facilities structure (Karataş et al., 2022c).

Terrestrial laser scanning has become highly important as a measurement tool in the architectural and cultural heritage fields due to its speed and accuracy. Laser scanning is particularly effective for the analysis and visualization of complex surfaces. It facilitates data interaction across different disciplines and reduces costs when documents are formatted appropriately (Ulvi et al., 2014). However, laser scanning has some disadvantages. For instance, obtaining drawings may be challenging if the data is very dense and complex, and edges may not be well-defined. Additionally, processing large amounts of data can be time-consuming. In conclusion, laser scanning is an essential tool in the architectural documentation process and is continuously evolving as a technology (Korumaz et al., 2010).

This study focuses on the use of Terrestrial Laser Scanning (TLS) technologies, which is a technology used in adaptive re-use projects in the field of architecture, as a new method in the distance education process of architecture. In this research, the use of terrestrial laser scanning technologies used in the field of architecture education as a method in adaptive re-use projects is examined by comparing it with the traditional method and its contributions are investigated. In this framework, answers to the following questions are sought. The main question of the research is 'Is the use of orthophoto produced from terrestrial laser scanning technologies within the scope of adaptive re-use of historical buildings an efficient method compared to the traditional method?' The sub-questions of the research are as follows, 'In which aspects is the use of orthophoto method an efficient method compared to the traditional method within the scope of adaptive re-use of historical buildings in architecture education? Are there any differences between the outputs obtained by orthophoto method and traditional method? If so, what kind of differences are there?

Orthophoto images obtained from TLS technologies will be used in the project of adaptive re-use of a historical building, and the conduct of the course in distance education will be investigated. While conducting this research, the face-to-face process of the course will be handled and the outputs of the control group of the previous period and the outputs of the

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experimental group in the distance education process will be evaluated by comparative analysis method. The concept of adaptive re-use, the course's operation, outputs, and evaluation criteria will be emphasized, and the findings will be evaluated by referring to the expert opinion.

LASER SCANNING TECHNOLOGIES

Laser scanning technologies are basically a measurement method that provides 3D point cloud data of that area by sending beams to an area or surface with a laser scanning device. Using Terrestrial laser scanning technology has many advantages such as producing real-like 3D models from complex geometries with high accuracy of 99.9% (+,- 2mm) measurement, reducing cost and labor, and saving time. Also, these technologies provide transform it into the required form by obtaining detailed and comprehensive data at once, providing measurement opportunities in dangerous or inaccessible areas where measurement is difficult. (Reshetyuk, 2006). Laser scanning application is used in different disciplines with processes involving similar steps. Point cloud data is collected with laser scanning devices installed at station points, and data collected from different points are combined, made usable and converted to orthophoto images (Kurultay and Birer, 2016).

Orthophoto Images and Phases in Orthophoto Production

Orthophoto image is a photogrammetry application in which a vertical projection is obtained by removing the camera angle, lens, height, or slope features that may cause errors in the perspective image of a place (Lillesand and Kiefer, 1994). Orthophoto images obtained with terrestrial laser scanning technologies accelerate the project processes in the field of architecture, urban or engineering, facilitate interdisciplinary use, and make it advantageous. While detailed measurements can be made from long distances with orthophoto images, large areas can be scanned in a short time and data can be obtained at a realistic level of detail (Fröhlich and Mettenleiter, 2004). By transferring the point cloud data obtained by terrestrial laser scanning technologies to the computer, it is possible to create 3D models of the measured area and to obtain drawings in the CAD environment. In this context, the orthophoto method is efficient in terms of time and cost.

Application stages in TLS technology consist of a series of successive processes. First of all, point cloud data of the area to be scanned or the surface to be scanned is obtained by terrestrial laser scanning measurement process where scanning data is needed. The obtained point cloud data is colored and subjected to preliminary data processing. Then, the point cloud data is combined by scanning from different points with the independent model method. The created point cloud is cleaned from unnecessary points that may cause errors. Point cloud data is transferred to the software for obtaining orthophotos. By creating the projection surface, parameters such as resolution and increment value that affect the quality and accuracy of the orthophoto are determined. With the settings made, orthophotos are created from the points determined in line with the needs. In the accuracy analysis phase, control points are selected over the orthophoto, analyze point cloud and coordinate system of the project. As a result, orthophoto images of the needed surfaces from the point cloud are obtained with high accuracy (Uzar and Öğütcü, 2016).

During laser scanning, the process steps are listed as follows:

• The device is placed at the station point determined according to the distances.

• The accuracy of the device levels is checked at the station point.

• Target points (CheckBorder) are placed on the surface to create a depth and height difference.

• An SD card is inserted into the device.

• Create New Project from Projects command is pressed, and the project is named.

• Parameters are entered. For example, one of the Indoor, Outdoor or Preview options is selected based on the distance. Resolution and quality values are entered according to the level of detail and sensitivity. The resolution and quality parameter settings screen is shown in Figure 1.

Figure 1. Resolution and quality parameter settings screen.

The precision of measurements and acceleration of project processes can be improved by eliminating errors caused by camera angles, lenses, and topographical features during the vertical projection process. TLS technology involves successive stages, from obtaining point cloud data through laser scanning to the creation of orthophotos, which require meticulous processes to generate detailed and accurate 3D models. This method is not only efficient in terms of time but also cost-effective. The use of TLS technology ensures precise calibration and positioning of the scanning device, resulting in high-quality orthophoto images with remarkable accuracy. Orthophoto images obtained from terrestrial laser

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scanning technologies offer a versatile and expedited solution for professionals in the architectural and engineering realms.

INVESTIGATION OF TERRESTRIAL LASER SCANNING TECHNOLOGIES VIA ADAPTIVE REUSE EXAMPLES IN ARCHITECTURAL EDUCATION

Conventional architectural education is a process that is carried out as theoretical and applied courses. Practical courses are usually design studios, technical drawing courses based on expression techniques, or construction courses for the implementation of the architectural product. Conventional design studios are design environments where educators and students can meet face-to face, providing shared reasoning, criticism, and discussion. The processes of transforming the abstract idea imagined by the students into a design product in a concrete way within the framework of a specific design problem and need are experienced in studio lessons.

In the curriculum of architectural education, re-functioning courses are included in order to ensure the sustainability of historical buildings by giving them a new function and to provide students with the ability to evaluate the existing building stock with a contemporary interpretation. Refunctioning courses are taught in parallel with the design studio.

Ensuring the continuity of the structures that were built to serve various purposes in different periods, with a new function, is a design process that architects will manage. To carry out this important process, there are courses within the framework of the concept of re-functioning in the curriculum of architecture departments. In the content of the courses, there are the concept of conservation, the methods to be used in the documentation and research of the current situation, survey restoration measurements and drawings, photography, image taking processes, spatial organization, requirement chart, scenario, concept, and function studies for the function to be determined, structural system design to eliminate structural deficiencies. Theoretical explanations and applications are made on topics that support the learning outcomes of the course, such as detail production, analysis and strengthening or redesign of the structure and construction system, and the production of sustainable solutions. At the end of the course, it aims to restore the existing building stock and to gain contemporary interpretation skills and awareness to meet today's needs.

The 'Adaptive Re-use of Existing Buildings' course is included in the elective course pool of architecture faculties providing undergraduate education, as a total of six hours, two hours of theory and four hours of practical. In their study, Balcı Yaşar and Yıldırım Gönül (2019) examined the courses in the undergraduate programs of 65 universities in Turkey and TRNC that provide education on Interior Architecture and Interior Architecture and Environmental Design and tried to determine the adequacy of undergraduate education in the formation of conservation awareness. According to the data, because of analyzing the courses within the scope of conservation with keywords, it was found that there were 12 courses within the scope of Adaptive Re-use (Balcı Yaşar & Yıldırım Gönül, 2019).

The process of the course, which is carried out with conventional methods, is carried out in parallel with the project courses and architectural studio approach. Students are expected to examine classical and contemporary structures with a holistic perspective and gain a sensitive and critical perspective.

The course usually focuses on an old building. First of all, comprehensive analyses of the historical building and its surroundings are made. The area and its surroundings are photographed in detail. To create the survey drawings of the current situation, the survey measurements are taken. The measured building and its immediate surroundings are transferred to the drawing. Damage assessment analysis is made from photographs and documents. Thus, the design process, which started with a sketch, can continue by making inferences about volumetric dimensions, space organization, and damage assessment, and the new function will be projected in a consistent manner. After the survey drawings, needs, deficiencies, and problems are determined. A new function is decided that will find a solution to all these and make the building reusable with a contemporary interpretation. After the function was determined, the scenario for the new function, spatial organization charts, and functional setup were made, and the design was started. Physical requirements such as structural system, acoustics, and lighting required by the design are evaluated by evaluating the current situation of the building and detailed with protection, repair, or additions.

The orthophoto method in architectural education can be used in the documentation of the current situation and in the design stages, especially in the courses where surveying, restoration, and adaptive re-use projects are the subject.

With the COVID-19 pandemic, emergency distance education has been introduced in education and education processes around the world. In this course, in which re-functionalization projects are designed, the use of terrestrial laser scanning technologies can be considered as an alternative to the creation of architectural documentation and survey drawings on orthophotos instead of fieldwork to eliminate the risk factor caused by pandemic diseases.

CASE STUDY

In this section, the experimental study carried out to investigate whether the use of orthophoto produced from Terrestrial Laser Scanning technologies is an efficient method compared to the conventional method is explained in detail within the scope of the refunctioning of historical buildings.

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Research Method

In this research, student project outputs obtained with the conventional and orthophoto methods were evaluated with a focus on the concept of re-use. Within the framework of the determined evaluation criteria, the use of terrestrial laser scanning technologies as a method in the distance education process and the conventional method used in the face-to-face education process were examined with the comparative analysis method. The general framework of the research is shown in Figure 2.

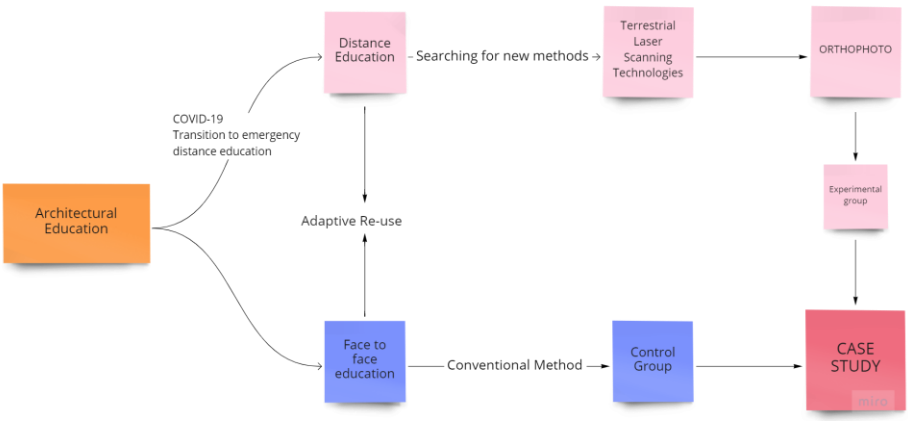

Figure 2. General Framework of the Research

Evaluations were made on 25 student projects. During the comparative analysis, opinions were taken from 3 experts on re-use, and the findings of the research were presented and interpreted.

In the experimental study, the answer to the question of whether the use of orthophoto, which is produced from TLS technologies, as a method within the scope of refunctioning historical buildings, was tried to be found that efficient method compared to the conventional method. Orthophoto images obtained from TLS technologies will be used in the project of re-use of a historical building, and the conduct of the course in distance education will be investigated. Orthophoto images, which are the outputs of the "Refunctioning of the Germiyan Church" project supported by the Istanbul Rumeli University Scientific Research Project, were used. It was thought that the use of orthophotos obtained by terrestrial laser scanning technologies in re-functional projects in architectural education could be an alternative method. In this context, plan, section, and view orthophotos documenting the current situation of the Germiyan Church, which is expected to serve as a basis for students, are shown in Figure 3.

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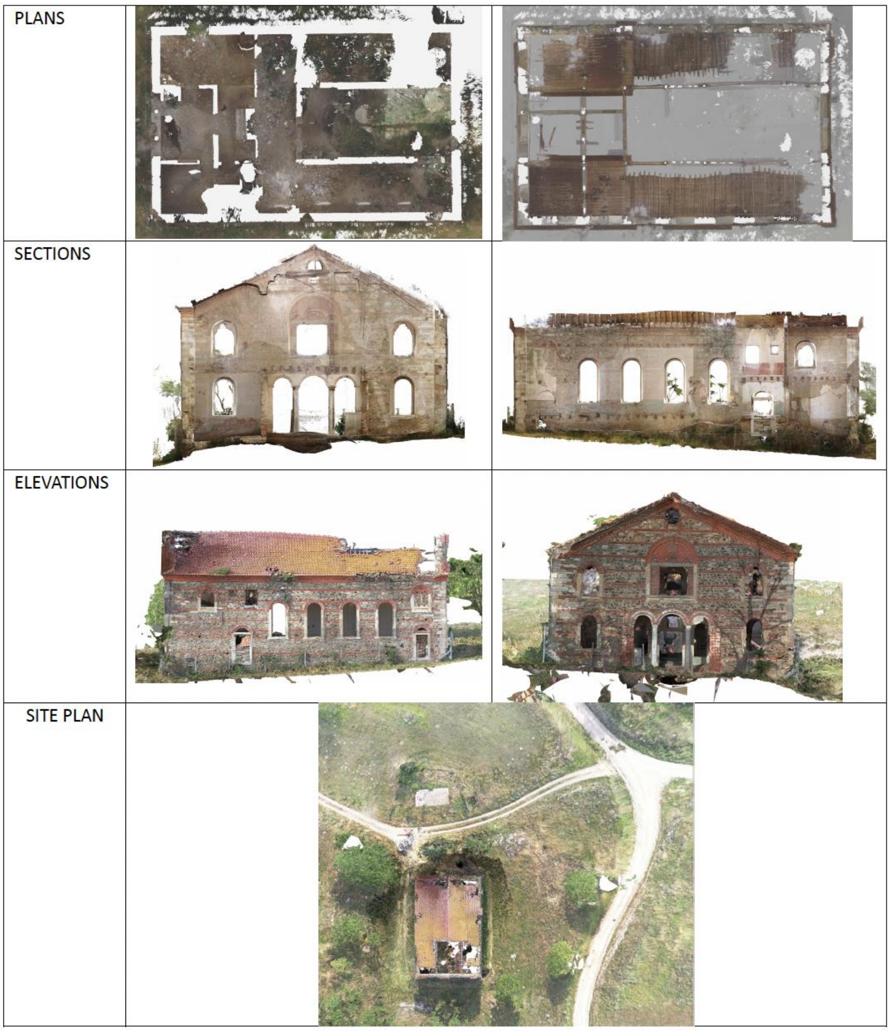

Figure 3. Germiyan Church Plans, Sections, Elevations, and Site Plan Orthophotos

The study is carried out within the scope of the Adaptive Re-use of Existing Buildings course at the Faculty of Engineering and Architecture of Istanbul Rumeli University. The final assignment of the course was carried out with 18 students in the distance education process and 7 students who took the course in the face-to-face education process in the Faculty of Architecture, completed the final assignment of the course. The course lasted a total of 14 weeks in both processes. Due to the COVID-19 pandemic, the participation of the TLS technology in the course in which the research was conducted and the process carried out with the orthophoto method as distance education and the process with the previous face-to-face conventional method were compared. Since a comparison will be made with the outcomes of the face-to-face education process in the period before the COVID-19 pandemic, the number of students taking research courses is limited. While making the comparison, the opinions of 3 experts with at least a master's degree in the field of surveying and restoration were consulted and evaluation criteria forms prepared by taking expert opinion were used. In the comparisons, the student outcomes obtained with the orthophoto method constitute the experimental group, and the student outcomes

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obtained with the conventional method constitute the control group. Evaluation points between 1 and 5 (1=Strongly Disagree, 2=Disagree, 3=Undecided, 4=Agree, 5=Strongly Agree) will be given with the Likert type survey measurement method. According to the scores, first of all, it will be examined whether the orthophoto method is efficient compared to the conventional method, and then it will be determined in which way they are efficient. While analyzing the data, the SPSS 28.0 program was used. To obtain the data to be used in the comparison, first of all, the normal distribution analysis of the groups was examined with the Shapiro Wilk (S-W) test (Bryman & Cramer, 2001). Afterward, Levene's test was performed to analyze the homogeneity of the variances of the groups. After the homogeneous distribution conditions were determined, to determine whether there was a difference between the normally distributed groups in terms of variables, the 'Independent Two-Sample t-Test' for the normally distributed variables and the 'Mann-Whitney U-Test' for the non-normally distributed variables were performed. While analyzing the data, the mean evaluation scores of each expression were also compared. Answers to open-ended questions directed to experts were used to interpret the findings. Finally, the general evaluation statement was included in the form, the success of the projects as a whole was evaluated between 1 and 5 in Likert type, and the results were given as average values. Selected outputs from both processes were brought together and categorized according to parameters and representations as orthophoto and conventional method processes, sample comparison tables were prepared and evaluated, interpreted according to the analysis results.

Findings

In this part of the study, the data obtained from the expert evaluation were statistically evaluated and student projects were analyzed comparatively. First of all, demographic information of the groups to be analyzed in the experimental study was included. The demographic information of the groups is shown in Table 1.

Table 1. Demographic information of the groups.

Variable		n	%
Gender Group	Woman	12	48
	Male	13	52
	Total	25	100
Education Group	Orthophoto Method	18	72
	Conventional Method	7	28
	Total	25	100

By analyzing the data obtained in the experimental study, the data obtained in the orthophoto method process, and the conventional method process were compared within the framework of the parameters. In the analysis, firstly, the normal distribution analysis of each variable was performed for the groups in the orthophoto and conventional method processes. The normal distribution analysis results for the groups are shown in Table 2.

Table 2. Normal distribution analysis results for education groups.

Variable	Group	n	Test Statistics	p
Design Features	Orthophoto Method	18	0,941	0,299
	Conventional Method	7	0,919	0,459
Three Dimensional and Space Perception	Orthophoto Method	18	0,961	0,613
	Conventional Method	7	0,887	0,259
Relationship with the Surroundings/Context	Orthophoto Method	18	0,926	0,167
	Conventional Method	7	0,829	0,079
Structural Features	Orthophoto Method	18	0,946	0,363
	Conventional Method	7	0,901	0,340
Analysis/Diagram Features	Orthophoto Method	18	0,892	0,041
	Conventional Method	7	0,933	0,579

Accordingly, the variables of Design Features, Three Dimensional and Space Perception, Relationship with the Surroundings/Context, and Structural Features showed normal distribution among the groups ($p>0.05$), while the Analysis/Diagram Features variable was not in normal distribution ($p<0.05$).

When comparing the orthophoto and conventional method processes, it was first checked whether the variances of the groups were homogeneous in the normally distributed variables to determine whether there was a significant difference between the groups. The analysis results for the variances of the groups are shown in Table 3.

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Table 3. Analysis results of the variances of the education groups.

Variable	F	p
Design Features	1,517	0,231
Three Dimensions and Space Perception	2,709	0,113
Relationship with the Surroundings/Context	3,658	0,068
Structural Features	5,807	0,024

Considering the average data of Design Features, Three Dimensional and Space Perception, Relationship with the Surroundings/Context, the variances of the groups for these variables are homogeneous (p>0.05), but not homogeneous for the Structural Features variable (p<0.05).

The comparison table of the differences between the education groups is shown in Table 4.

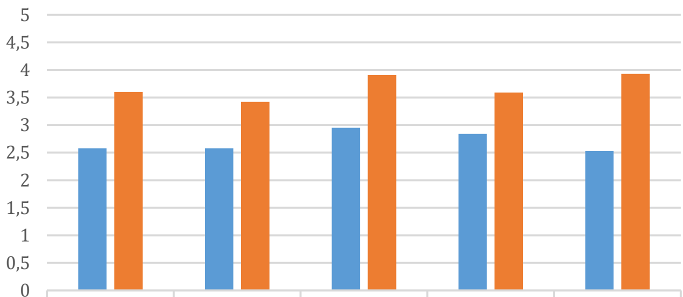
Table 4. Comparison of the differences between education groups.

Variable	Group	n	Mean ± S.D.	Test Statistics	
				t	p
Design Features	Orthophoto Method	18	3,60 ± 0,70	2,902	0,008
	Conventional Method	7	2,58 ± 1,00		
Three Dimensions and Space Perception	Orthophoto Method	18	3,42 ± 0,70	2,247	0,035
	Conventional Method	7	2,58 ± 1,15		
Relationship with the Surroundings/Context	Orthophoto Method	18	3,91 ± 0,63	2,756	0,011
	Conventional Method	7	2,95 ± 1,08		
Structural Features	Orthophoto Method	18	3,59 ± 0,77	1,433	0,191
	Conventional Method	7	2,84 ± 1,28		
Variable	Group	n	Median (min.; max.)	Test Statistics	
				z	p
Analysis/Diagram Features	Orthophoto Method	18	3,93 (3,00; 4,60)	-3,338	<0,001
	Conventional Method	7	2,53 (1,13; 3,20)		

According to the results of the analysis, there is a significant difference between the education groups for these variables when the average data of the variable's Design Features, Three Dimensional and Space Perception, Relationship with the Surroundings/Context and Analysis/Diagram Features are considered (p<0.05). There was no difference between the education groups for the Structural Features variable (p>0.05).

To compare the differences between the education groups, the average values of the evaluation scores given by the experts are shown in Table 5.

Table 5. Comparison of the average scores of the project outputs in the orthophoto method and conventional method processes according to the evaluation criteria.



	Design Features	Three Dimensional and Space Perception	Relationship with the Surrounding/ Context	Structural Features	Analysis/ Diagram Feautres
Conventional Method	2,58	2,58	2,95	2,84	2,53
Orthophoto Method	3,6	3,42	3,91	3,59	3,93

Conventional Method   Orthophoto Method

According to these data, it was seen that the average scores of the student projects in the process where the orthophoto method was used in all parameters were higher than the projects made in the conventional method process. It is seen that the biggest difference in the averages is in the title of Analysis/Diagram Features, then in the title of Design Features, Relationship with the Surroundings/Context, Three Dimensions, and Space Perception and Structural Features, respectively. Accordingly, it can be said that the orthophoto method makes a significant difference compared to the conventional method in defining the functions of the buildings, conveying the relations of the spaces, and expressing the design features schematically.

Design Features (Color, Texture, Material)

An evaluation form was directed to the experts and 5 different expressions supporting this title were evaluated under the title of Design Features. The average answers of the experts were compared for the education processes using the orthophoto and conventional methods and are shown in Table 6.

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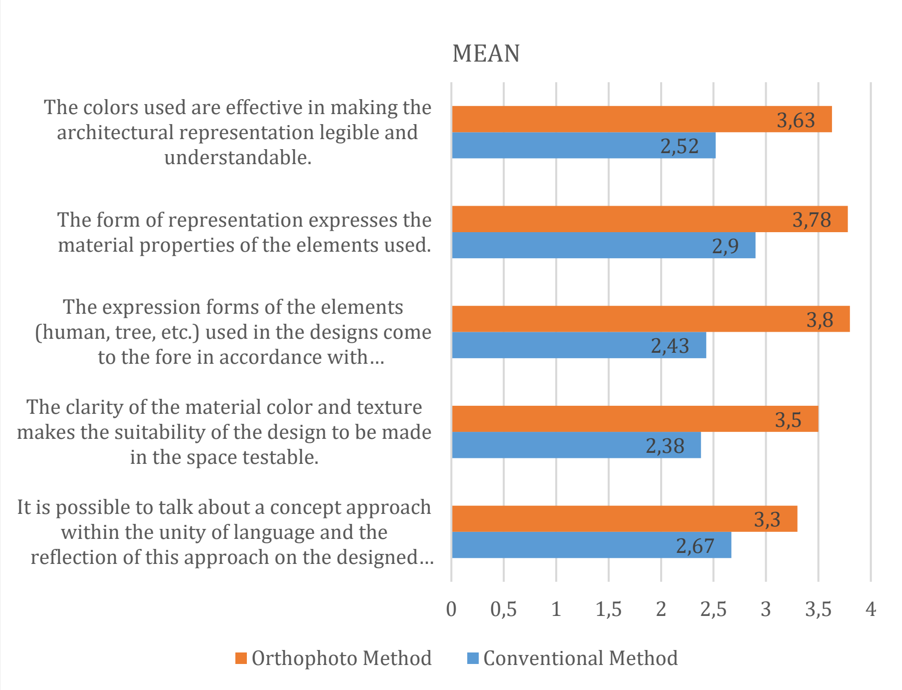
Table 6. Averages of Design Features indicators in conventional and orthophoto method processes.



According to the expert opinions, the students who got the highest score in their group for this category, with an average of 4.73 points for the conventional method example and 3.69 points for the orthophoto method example. According to the expert answers given to the open-ended questions for the two projects, for which the sample comparison table is given, it was seen that the structure of the project was well expressed with three-dimensional expression in the column and dome details in the conventional method process, and the material and structural features were found positive in the modeling of the outdoor space. The most negative side is the lack of explanation about the design decisions, the lack of the site plan and the inability to resolve the building relations. In the process of the orthophoto method, the most positive feature is the ability to create a language unity in the design by using color and material correctly, while the most negative feature is the explanation of how the building relates to its site in three dimensions and that the other designed structures are not detailed.

As a sample comparison table within the scope of the Design Features criterion, the layout plan, floor plan, section and mode sheet of the projects prepared by the students, one sample from the conventional method process and one sample from the orthophoto method process, were examined and compared within the framework of the design features parameter, which is one of the evaluation criteria. The outputs of this comparison are shown side by side in Figure 4.

When the outputs in Figure 4 are compared, it has been seen that the road, building, green area, hard ground, and parking parts are separated by using different colors, thus making the plan more understandable and readable. In 1A, only the buildings were painted, and it is thought that the environmental data remained expressionless.

In 2B, this time, not only color but also forms of expression that will enable materials to be recognized and show texture have been preferred, thus increasing the sense of reality.

The plan has been made readable, and it is seen that a representation style with a three-dimensional effect is used compared to 2A, even if it is on the plan plane.

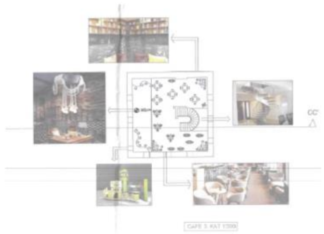
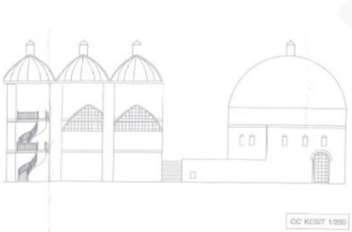
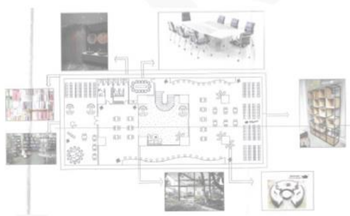
	1. Design Features (Color, Texture, Material)		
		A-Conventional Method	B-Orthophoto Method
1	Site Plan		
2	Plan		
3	Section		
4	Mod Sheet		

Figure 4. Design Features (Color, Texture, Material) sample comparison table

Although it is stated by the student that 3A is a sectional drawing, it cannot be clearly understood from the representation that it is a section or view. There is no data in the representation that makes the material understandable. Also, the connection points (the vertical junction of the dome) are considered to be inexpressive. In the elevation part of 3A, no material was identified on the facade. In 3B, first of all, it is possible to read that the drawing is a section, from which material the building is made and the color of the material. The clarity of the material color and texture makes the suitability of the design to be made in the space testable. It can be mentioned in a design approach within the unity of language in the space.

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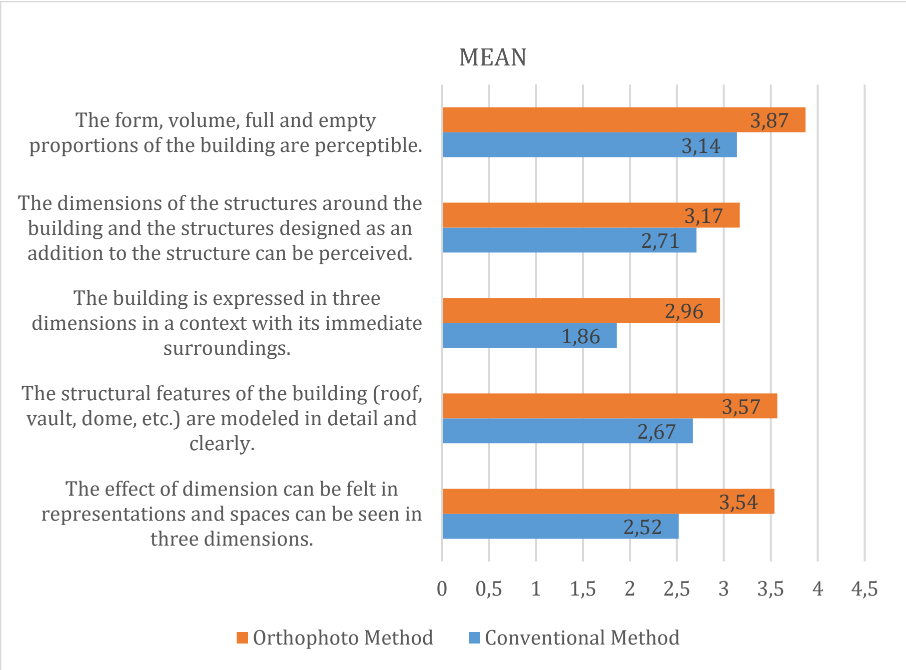
There is no data on the material of the building is defined in 4A. Therefore, only the formal suitability of the selected furniture can be interpreted. It does not seem possible to evaluate in terms of color. In 4B, the data of the building and the furniture in it are understandable in terms of material. Therefore, the suitability or incompatibility of the selected furniture in terms of color can be examined.

Three Dimensional and Space Perception

An evaluation form was directed to the experts and 5 different expressions supporting this title were evaluated under the title of Three Dimensional and Space Perception. The average answers of the experts were compared for the orthophoto and conventional method processes and are shown in Table 7.

Table 7. The averages of the Three Dimensional and Space Perception indicators in the conventional method and orthophoto method processes.



In the project outputs of the students in the conventional and orthophoto method process, a comparison was made over perspective, facade, and sections, and evaluated in terms of three dimensions and space perception. Perspective, elevation, and section representations that can be compared from both sample groups are given in the sample comparison table. The data for the comparison made are shown in Figure 5.

According to Figure 5, the three-dimensional work done in 1A makes the shape, volume, full and empty proportions of the structure perceptible, but it is not clear from which material the structure is made. Details of the facade surfaces are not defined, so there is uncertainty between paint, exposed concrete or stone coating materials. The additional glass structure near the building can be understood at first view, and the three-dimensional expression of the building with its surroundings was found positive in the opinions of the experts.

Although a dark atmosphere is preferred in 1B, the structure looks more realistic. This expression resembles a realistic photo frame rather than modeling. According to expert opinions, the most positive aspect of the project is the abstract processing of the data on the real appearance in an expressive way and the understanding of the interior perspectives.

In 2A, the structure is perceived as three-dimensional, but the structure-ground connection seems far from reality. Therefore, the building was designed as a stand-alone three-dimensional object detached from the context. It is not possible to form an idea about the surroundings of the building. In the evaluations, color, definitions, pedestrian, and vehicle roads were found to be missing in the site plan. The structural features of the building (vault, dome, etc.) are modeled in a detailed and understandable way.

The most positive aspect is that the column and dome details of the building are well expressed with a three-dimensional expression. In 2B, the structure analysis was positive. Although the wall texture can be partially understood, it is thought to look three-dimensional and realistic beyond the texture coating. The negative feature is that the building is not handled in three dimensions with its surroundings.

3A and 3B display a very similar façade character, both of which are stone walls. However, even if it is a facade drawing, the stone wall also has a dimension effect, and this dimension effect is thought to be caused by working with realistic orthophoto images and using abstractions such as humans and trees. With the orthophoto, the stone wall is almost at the level of detail that can be seen. In 3A, the stone wall drawing is far from reality and does not reflect the stone wall character.

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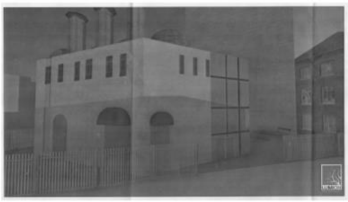
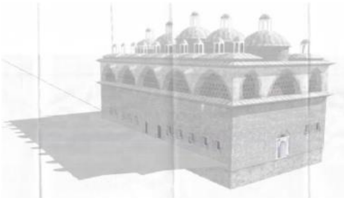
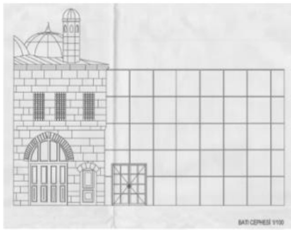
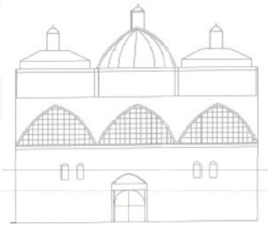
		2. Three Dimensional and Space Perception	
		A-Conventional Method	B-Orthophoto Method
1	Perspective		
2	Perspective		
3	Facade		
4	Section		 

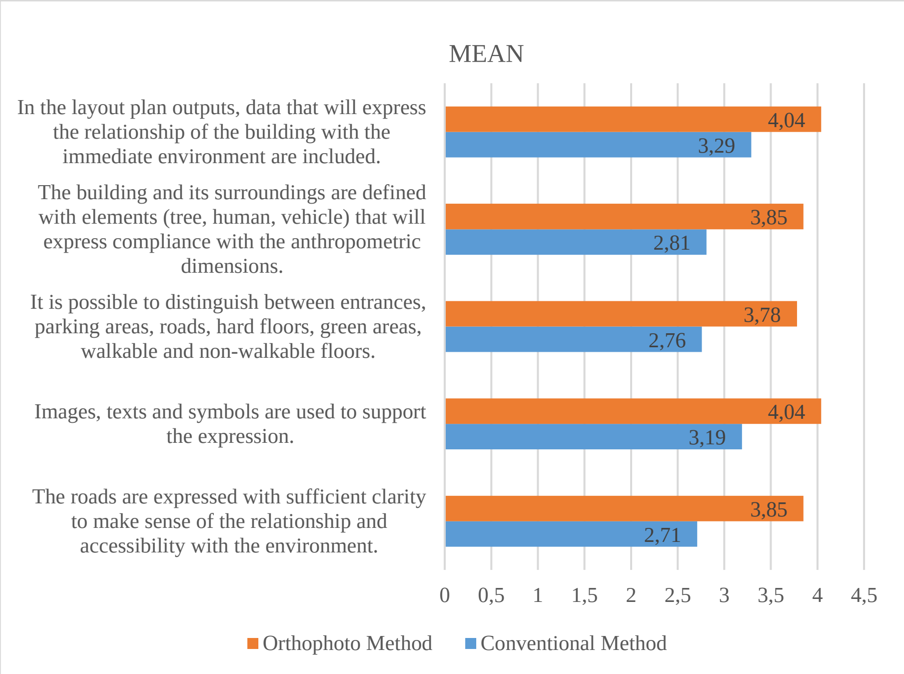
Figure 5. Three Dimensional and Space Perception sample comparison table

The most positive part of the project is that the immediate surroundings of the building are expressed in a context with three-dimensional expressions. The drawing expresses that the original facade can still be seen as the entrance is designed as glass, and the accuracy of this design idea can be evaluated. When the facade representations are considered in general, it is thought that the effect of technical drawing decreases in the outputs of the orthophoto method process. Since distance cannot be perceived in 4A, the perception of size is lost accordingly. In 4B, it is thought that the use of the real facade in the background directly affects the perception of size.

Relationship with the Surroundings / Context

An evaluation form was directed to the experts, and it was ensured that 5 different expressions supporting this title were evaluated under the title of Relationship with the Surroundings/Context. The average answers of the experts were compared for the orthophoto and conventional method processes and are shown in Table 8.

Table 8. Average of Relationship with the Surroundings/Context indicators in conventional method and orthophoto method processes.



A comparison was made on the project outputs of the students in the process of conventional and orthophoto method, over the site plans, and the relationship of the buildings with the surroundings and the context features were evaluated. The data for the comparison made are shown in Figure 6.

In the site plan outputs in the orthophoto method process, data that will express the relationship of the building with the surroundings are included. With the use of texture and color, roads, hard floors, green areas, walkable and non-walkable floors can be distinguished. Entrances and parking areas are defined. Visuals, texts, and symbols are used to support the expression.

On the other hand, it is seen that the use of limited colors is included in the layout plan outputs in the conventional method process. The roads are not expressed clearly enough to make sense of the relationship and accessibility with the environment. Floor coverings do not contain data on the distinction between hard and soft floors. Green areas are not clearly defined, only linear separation or tree furnishing is made, so there is uncertainty about the boundaries of green areas. The relationship between the building and the surrounding structures is weak. Vehicle and pedestrian roads are not defined, landscaping is generally not visible.

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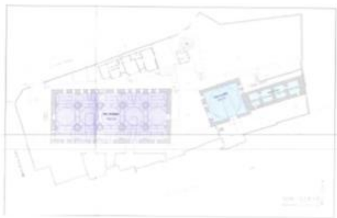
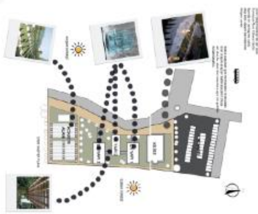
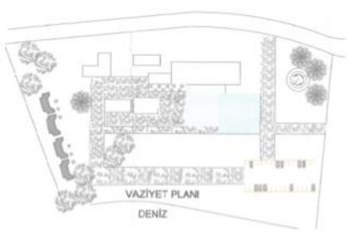
	3. Relationship with the Surroundings/Context		
		A-Conventional Method	B-Orthophoto Method
1	Site Plan		
2			
3			
4			
5			
6			

Figure 6. Relationship with the Surroundings/Context example comparison table

Structure Features

An evaluation form was directed to the experts and 5 different expressions supporting this title were evaluated under the title of Structural Features. The average answers of the experts were compared

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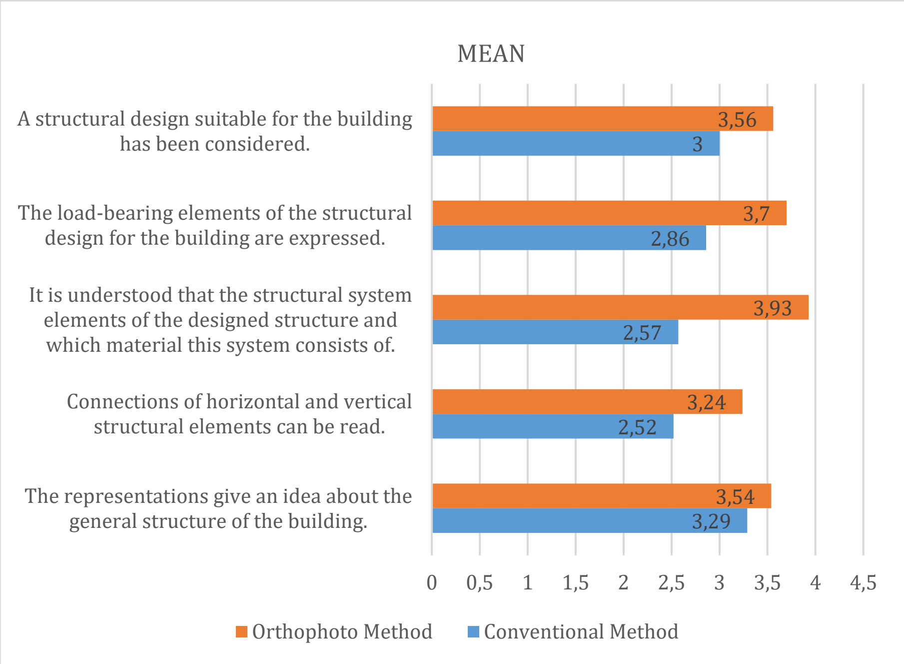
for the orthophoto method and conventional method processes and are shown in Table 9.

Table 9. Averages of Structural Features indicators in conventional and orthophoto methods.



The structural features of the buildings were evaluated by making a comparison over the sections in the project outputs of the students in the conventional and orthophoto method process. The data for the comparison made are shown in Figure 7.

According to Figure 7, it was seen that the structure was not considered sufficiently in 1A and only the thickness of the top cover was expressed. There is no statement regarding the material of the top cover. In 1B, it is understood that the structural system and what material this system consists of. The most positive aspect of the project is that the roof and joint details are expressed in the structure system in an explanatory way and the roof structure is found to be suitable for the structure.

While 2A contains a more technical expression, 2B contains a more schematic explanation. The faint expression of the stone wall in the background, which appears in 2B, provided a simpler understanding of the section.

In 3A, it is seen that the structural features are not understood, and the horizontal and vertical element connections are uncertain. General structure and connection details are incompletely expressed. However, it is thought that the details of the dome of the building are well expressed in the three-dimensional expression, and it is positive in the opinion of the expert. Although structure details cannot be understood in 3B, the material of general structural elements can be understood. This has been the most positive aspect of the project.

In 4A, the structural system setup was found to be positive, but it is thought that the structure expressions can be given more clearly in the section. It is stated in 4B that the general structure of the building is

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understandable. The structural setup and three-dimensional expression in the space are among the most positive aspects of the project. The drawing has been brought closer to the technical drawing language with annotations.

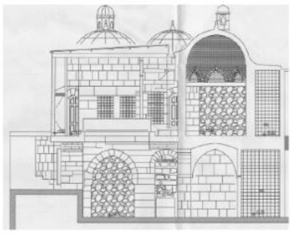
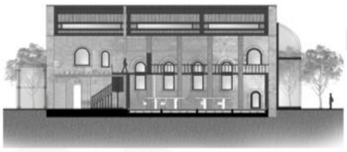
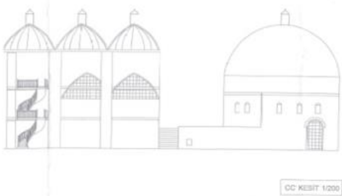
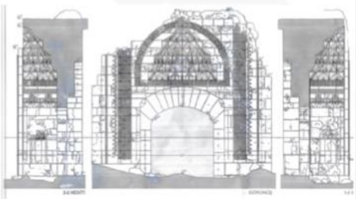
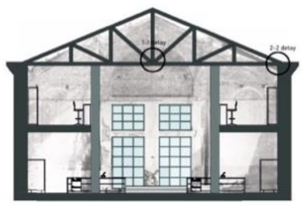
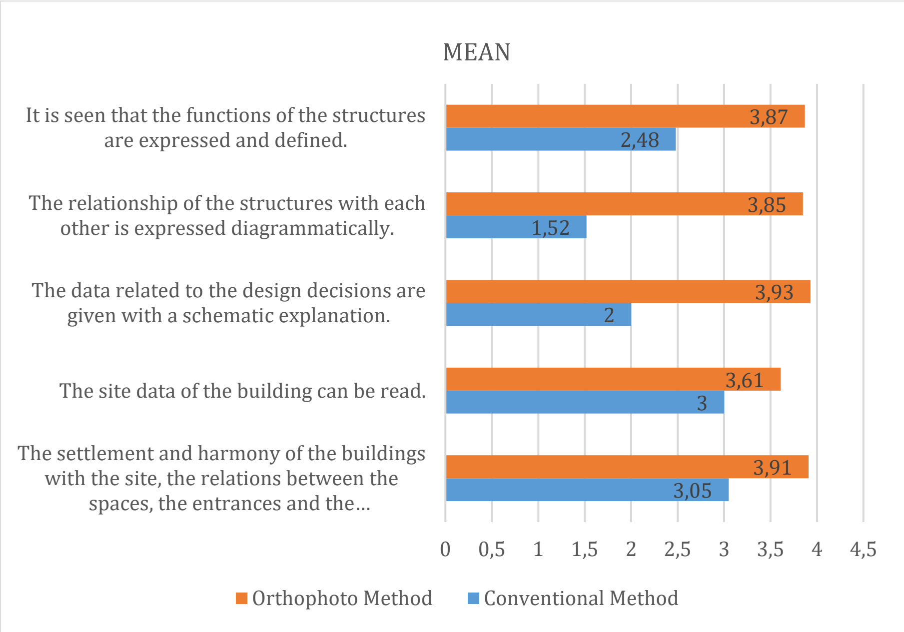
	4. Structural Features		
		A-Conventional Method	B-Orthophoto Method
1	Section		
2			
3			
4			

Figure 7. Structural Features sample comparison table

Analysis / Diagram Features

An evaluation form was directed to the experts, and it was supported that 5 different expressions supporting this title were evaluated under the heading Analysis/Diagram Features. The average answers of the experts were compared for the orthophoto and conventional method processes and are shown in Table 10.

Table 10. Averages of Analysis / Diagram Features indicators in conventional method and orthophoto method processes.



The analyzes and diagrammatic expressions of the projects prepared by the students during the conventional and orthophoto method were compared. The outputs of this comparison are shown side by side in Figure 8.

When the data in Figure 8 are compared, it is seen that the functions of the structures are expressed and defined in the outputs of the orthophoto method process. The relationship of the structures with each other is expressed diagrammatically. Data on design decisions are included. In 4B, the function chart that defines the spatial organization and needs program and the diagram that shows the new state of the old building after the functionalization are used. In the three-dimensional terrain model, which shows the approach in 3B, site data, roads, settlement, and harmony of structures with the site, relations between spaces, entrances, transportation axes to the structures are described. In expert opinions, one of the most positive aspects of the project was its analysis.

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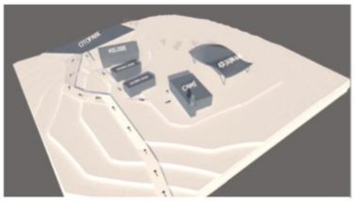
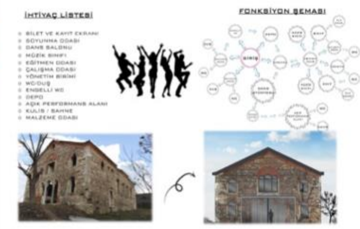
	5. Analysis/Diagram Features		
		A-Conventional Method	B-Orthophoto Method
1	Analysis Sheet		
2			
3			
4			

Figure 8. Analysis / Diagram Features sample comparison table

In both processes, it is seen that real photographs of the structures are used in the project outputs, and satellite images are preferred to show the location information.

CONCLUSION AND RECOMMENDATIONS

The use of digital technologies has become inevitable, especially during the pandemic. In this period, it has been difficult for students to move away from traditional methods, especially in applied fields such as architecture and design. In these experience-oriented fields, it is thought that technology should be integrated with traditional methods in distance education to achieve success.

In their study, Özgüven et al. (2020) examined in distance education at Maltepe University Faculty of Architecture and Design in the spring semester of 2019-2020, design studios were conducted online. However, students' methods of expressing their design projects differed from traditional approaches. The projects, which were expressed in a virtual environment using digital tools such as three-dimensional modelling and screen sharing instead of tangible materials, differed among students depending on their proficiency levels. This situation triggered the search for new methods and revealed thought processes related to time, space and method (Özgüven et al., 2020). In this context, in this study, the use of TLS technologies in the adaptive reuse projects of architecture in the distance education process was examined by comparing it with the traditional method in the face-to-face education process and its contributions were investigated.

Considering the mean data and distributions of the Design Features, Three Dimensional and Space Perception, Relationship with the Surroundings/Context, and Analysis/Diagram Features variables, it was seen that there was a difference between the education groups for these variables, and there was no difference between the education groups for the Structural Features variable. On the other hand, according to the comparison, it was determined that the success averages of the orthophoto method were higher than the averages of the conventional method in all criteria. In the orthophoto method, the harmony of the designs in the projects to the anthropometric dimensions, the three-dimensional expression of the new structure with the environment, the accessibility, the structural elements and materials, and the relational definitions of the structures were found to be quite productive compared to the conventional method process. The least differences between the groups on average were the creation of a concept in a linguistic unity, expressions about the dimensions of the structures, the site plan and its relationship with the immediate environment, information about the general structure setup, and the ability to read the field data. Accordingly, it can be said that while there is little difference in general expressions, the difference in details that will highlight and contribute to the project is large for the two method processes, and the orthophoto method stands out at these points.

When the evaluation of the project is analyzed in expert opinions, the average of the orthophoto method process is 3.39; the average of the conventional method process was determined as 2.71. This means that when the projects are evaluated as a whole, those in the orthophoto method process were found to be more successful than those in the conventional method process.

As a result, while it is thought that the orthophoto is detailed in terms of color and texture, it is thought to offer a closer reality to the experienced space, it is thought that students can not present realistic visuals because the technical drawing is far from the real image, because it cannot be visualized in 3D in their minds. It is seen that orthophoto image data provides a holistic perspective in design and allows students to test color, material, and texture harmony while designing. Students can try the harmony of orthophoto and building designs added later to the building and make inferences about the structural system. In addition, they can easily detect traces of old artifact with orthophotos, make period and damage analyses, and create protection, repair, and intervention decisions.

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During the orthophoto method process, Autocad for scaled and technical drawing, Sketchup for modeling and realistic images, and Photoshop for design, image correction, layout design, and presentation were used. However, the most important point to be mentioned here is that the Photoshop program is used directly during the design phase. Facade character, use of materials, colors, textures, and appropriate structural design were tested on real-scale photographs, and their suitability was evaluated. The students decided on their designs based on these experiments. For this reason, the fact that the orthophoto is scaled and real images documenting the current situation is considered positive in terms of its use in design. Since the representation will be made on real images, it would be appropriate to use realistic representations to ensure harmony. It is thought that the fact that the orthophoto is very close to reality enables the development of 3D thinking and perception. In the process where the orthophoto method was used, the drawing and presentation quality of the students increased compared to the conventional method. In addition, orthophoto because it contains more data such as damage detection, material analysis, structure, etc. has increased the knowledge to be used in design inputs according to existing CAD plans.

It is thought that being able to access measurable, comparable, and high-accuracy data without going to the place is an alternative and useful method in the emergency distance education period. In the use of TLS technologies, the time gained from the surveying process brought by the orthophoto is seen as an advantage. However, the application of site study and learning methods by practice is important for the development of the student's mastery of the process and should not be ignored.

In future studies, it is foreseen that the research will lead to new discussions on originality, creativity, and the use of different 2D, 3D, and hybrid techniques and presentation tools in presentation formats, since each project is designed on the supplied ready-made bases. Student outputs can be evaluated within the framework of design success, technology usage capacity, habit, and desire to use the internet and new media, and the method used can be associated with these parameters. The question of whether giving orthophoto data to students as a base affects design and creativity can be examined.

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